J Raptor Res. 27(3):149–153

DO PEREGRINE FALCON FLEDGLINGS REACH INDEPENDENCE DURING PEAK ABUNDANCE OF THEIR MAIN PREY?

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ABSTRACT.—Peregrine Falcons (*Falco peregrinus*) in southeast Australia are said to hatch their young when prey is most abundant. Fledgling and adult prey numbers, however, peak after Peregrine Falcon young fledge and not while they are in the nest. This may increase survival of young Peregrine Falcons by allowing them time to learn to hunt difficult prey.

¿Los volantones de *Falco peregrinus* alcanzan su independencia durante el máximo de abundancia de su presa principal?

RESUMEN.—Se ha documentado que *Falco peregrinus*, en el sudeste de Australia, independiza a los juveniles cuando la presa principal es más abundante. Sin embargo, la máxima abundancia de volantones y adultos de la presa ocurre después de que los juveniles de *F. peregrinus* dejan el nido, y no mientras ellos stán en él. Esto podria incrementar la supervivencia de los juveniles de *F. peregrinus*, por un aumento del tiempo disponible para aprender a cazar presas difíciles.

[Traducción de Ivan Lazo]

Two major studies of the diets of Peregrine Falcons (*Falco peregrinus macropus*) in southeast Australia have established that Peregrine Falcons prey almost exclusively on birds. In Victoria, Galah (*Cacatua roseicappila*), Crimson Rosella (*Platycercus elegans*), Eastern Rosella (*Platycercus eximius*), Rock Dove (*Columba livia*), and European Starling (*Sturnus vulgaris*) were the main prey during the breeding season (60.75% by number, ca. 90% by weight; Pruett-Jones et al. 1980). Peregrine Falcons near Canberra showed similar tendencies in a year-round study of diet (P. Olsen, J. Olsen and I. Mason unpubl.). Ninety-six percent of prey items were birds and, as in Victoria, Galahs, Crimson Rosellas, Eastern Rosellas, Rock Doves and European Starlings were the main prey (66% of the breeding and nonbreeding diet by number). In both studies, these five main prey species made up about 90% of the diet by weight, and parrots made up about 50% of the diet by weight.

Rock Doves are available year round as prey in southeast Australia because they breed year round (Frith 1982) and some are used throughout the year for pigeon racing. The other four species breed seasonally, but nest in tree cavities so nestlings are not readily available as prey. However, their fledged young, which have a pronounced peak in abundance each year, are available to Peregrine Falcons as prey.

Lack (1966) surmised that breeding seasons of single-brooded species had evolved so their young normally hatch in the most favorable period for parents to raise them, usually when food is most abundant. However, it is not clear whether Peregrine Falcons breed when peak food abundance and availability coincide with: 1) peak demand for food by the female when preparing her eggs, 2) when parents are feeding young in the nest, 3) when the young have fledged but are still dependent on food gathered by the parents, or 4) after young reach independence. Newton (1979) applied Lack's ideas to raptors and concluded that raptors are feeding young during the period of peak food supply. The prey most easily captured are fledglings and juveniles that have just left the nest and can move around but cannot fly strongly. Newton (1986) found that the first appearance of prey fledglings ended the season of lowest food supply for Sparrowhawks (*Accipiter nisus*), and that the hawks first laid eggs 5–10 days after fledglings of prey species first appeared. He also found that the majority of the hawks had young when prey fledgling supply peaked. Fledglings formed more than half of all prey eaten by Sparrowhawks at this time.

Young of arctic Peregrine Falcons (*F. p. tundrius*) are also said to hatch when prey is most abundant (Cade 1960, Harris 1981). This finding is supported

by studies in South Greenland where the first fledging passerines—Wheatears (*Oenanthe oenanthe*), Redpolls (*Carduelis flammea*), Lapland Longspurs (*Calcarius lapponicus*) and Snow Buntings (*Plectrophenax nivalis*)—emerge when Peregrine Falcons are hatching their young. These species are primary prey of Peregrine Falcons in this region (Falk and Moller 1988).

Pruett-Jones et al. (1980, p. 261) suggested that, for Peregrine Falcons in southeastern Australia, ". . . the young hatch when other species that act as prey ought to be most abundant" and Olsen (1982, p. 288) states ". . . the main flush of adult and fledgling prey coincides with the nestling and fledgling periods of the peregrine." However, the breeding times of prey species were not examined in either of these papers.

An alternative view is that just-fledged Peregrine Falcons in southeast Australia have fledgling Galahs and other parrots available so they can learn to hunt this easier prey instead of more experienced prey (Olsen 1974, Sherrod 1983). The Peregrine Falcon nestling period would occur before the peak in prey abundance.

In this study we compare Peregrine Falcon breeding phenology in Victoria and near Canberra with the seasonal abundance of nestling, fledgling, and adult Galahs, Crimson Rosellas, Eastern Rosellas and European Starlings. We examined the two hypotheses developed above which predict either a close match between a peak in prey abundance and a peak in food needs during the nestling period or shortly after fledging or, alternatively, a peak in prey abundance after Peregrine Falcon young have fledged and are reaching independence.

MATERIALS AND METHODS

We based our analysis on four separate data sets: banded nestlings, the Australian Nest Record Scheme, a survey of fledged dependent young, and a survey of monthly bird numbers.

Banding Records. Nestling Peregrine Falcons and their prey are typically banded about 1–2 wk before fledging when their legs are full grown but before there is a risk of premature fledging through disturbance. Because of this it is possible to use banding records to estimate the fledging dates of Peregrine Falcons and their main prey. In our first analysis, we used banding dates for nestling Galahs, Eastern Rosellas, Crimson Rosellas and European Starlings from southern Australia. We compared these data to banding dates for Peregrine Falcons in Victoria (Emison and Bren 1980). Statistical analysis follows Sokal and Rohlf (1969).

Nest Record Scheme. We extracted from the Nest Record Scheme the months from 1975–83 when nestling Galahs, Crimson Rosellas, Eastern Rosellas and European Starlings were found in nests in Victoria and near Canberra. This data set consists of records submitted by amateur and professional ornithologists around Australia of any nests visited that contain eggs or nestlings. Where they recorded more than one visit to a single nest, only the last record of nestlings was used. Thus, in our analysis, these data are of older nestlings just before fledging. We compared these records, by month, to data for 5-wk-old Peregrine Falcon nestlings (peregrines fledge at about 6 wk) near Canberra (calculated from data in Olsen and Olsen 1989).

Recently Fledged Young Near Canberra. The third data set came from a survey by the Canberra Ornithologists Group. We compared months when ornithologists saw fledged dependent young of the four main prey species near the Canberra Peregrine Falcon study area to the months when these peregrines had nearly fledged nestlings as in the second data set. Where a number of sightings of the same brood were reported in the Canberra Ornithologists Group data, only the earliest sighting is counted This gives the earliest dates that young were available as prey to peregrines.

Bird Counts Near Canberra. In a fourth data set, we analyzed 42 monthly estimates of all bird species counted near the Canberra Peregrine Falcon study area (Olsen et al. 1991) to determine whether the 77 species in general, and the four main prey species in particular, peaked in abundance while peregrines near Canberra had nestlings (Oct.–Dec.) or while their young were fledging and achieving independence (Jan.–Mar.).

The banding and Nest Record Scheme data indicated when prey species were likely to be available to Peregrine Falcons as fledglings, though the evidence was indirect. The data on bird abundance from Olsen et al. (1991) showed the total abundance of adult and fledgling prey birds during the peregrines' nestling period (Oct.–Dec), and while Peregrine Falcon chicks are achieving independence (Jan.–Mar.). The data for recently fledged young from the Canberra Ornithological Group provided the most direct estimate of availability of recently fledged prey during the late Peregrine Falcon nestling period immediately before those peregrines fledge.

RESULTS

Banding Records. The banding data for young Eastern Rosellas, Crimson Rosellas, Galahs and European Starlings spanned 5 mo with most nestlings banded in Oct.–Dec., the same months in which peregrines were most frequently banded (Fig. 1). With the possible exception of early Galah broods, the majority of prey species appear to fledge either at the same time (Nov.–Dec.) or after young peregrines fledge. When all prey were compared to all prey except European Starlings in Fig. 1, the mean, standard deviations and ranges were similar indicating that introduced European Starlings fledge

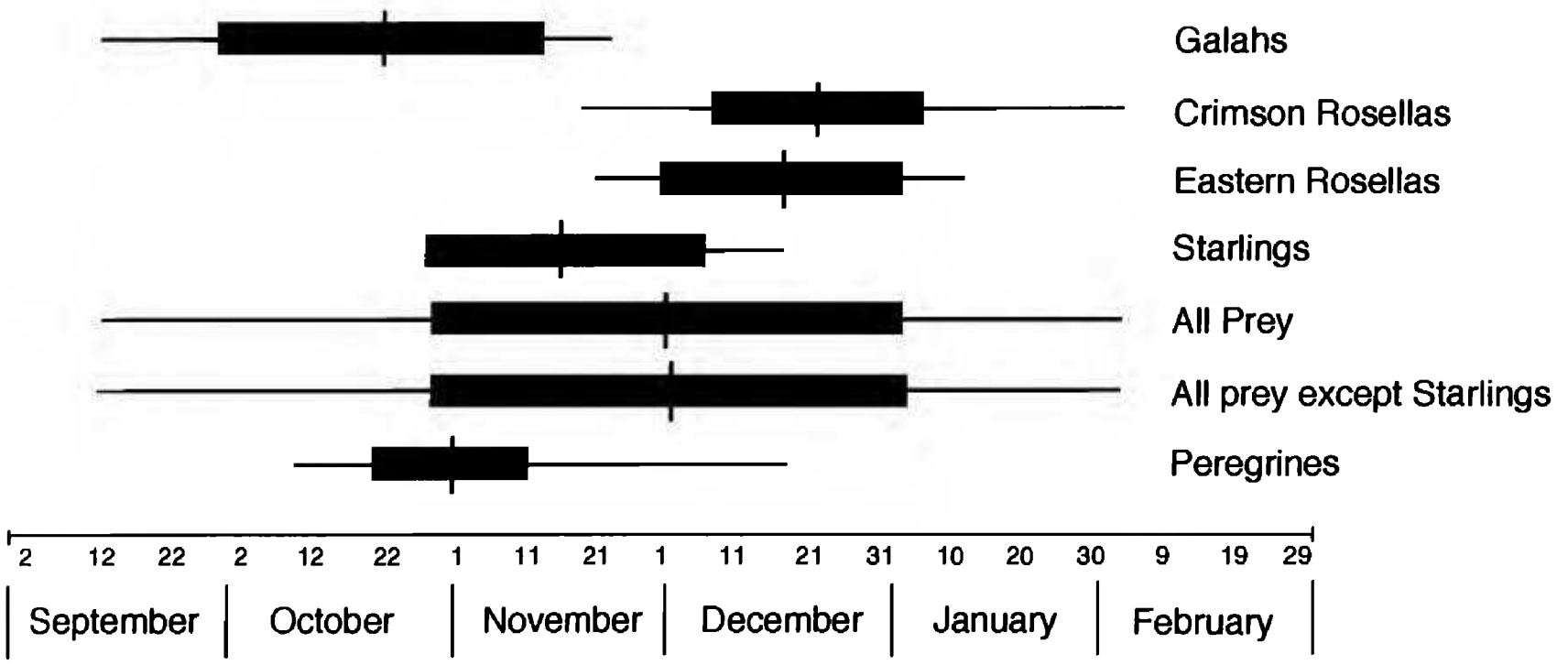

Figure 1. Mean dates, standard deviations and ranges for dates when nestlings of the four main prey species and Peregrine Falcons were banded.

young at about the same time of year as native species. These results do not support the hypothesis that Peregrine Falcon hatching coincides with a peak in food. Because all of these prey species breed in tree cavities, the nestlings are unavailable as prey. Instead, peak abundance in prey species appears to occur after the peregrine offspring have fledged.

Nest Record Scheme. Nestling records for Eastern Rosella, Crimson Rosella, Galah and European Starling from the Nest Record Scheme, generally support the data from the banding scheme. Here again the data clearly demonstrated a peak in nestling abundance coinciding with or following the peregrine nestling period (Table 1).

Recently Fledged Young Near Canberra. Counts of recently fledged young of the four main prey species generally supported the data from the banding and Nest Record Scheme. They showed a peak in abundance after Peregrine Falcon young had fledged though there appeared to be numbers of fledgling European Starlings available while peregrines had nestlings (Table 1).

Table 1. Percent of young seen, in each month, of the four main prey species of Peregrine Falcons in southeast Australia (a = latest entries for each nest in the Nest Record Scheme, i.e., the last time young were seen in that particular nest. b = first records for just fledged dependent young from the Canberra Ornithological Group data, i.e., the first time fledged young were seen for each brood reported, and c = peregrine nestlings estimated from Olsen and Olsen (1989) to be 5 wk old).

		PERCENT OF YOUNG SEEN					
	(*N*)	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.
Eastern Rosella	a-75			44	39	15	1
	b-31	3	3	3	48	36	7
Crimson Rosella	a-63			16	75	10	
	b-55		6	9	29	38	18
Galah	a-43	19	16	56	9		
	b-78			30	36	19	15
European Starling	a-835	1	30	38	28	3	
	b-70		26	43	30	1	
Totals for main prey species	a-958	5.0	11.5	38.5	37.75	7.0	0.25
	b-234	0.75	8.75	21.25	35.75	23.5	10.0
Peregrine Falcon	c-234		3	91	6		

Table 2. Average number of birds seen per month of 77 potential prey bird species and of the four main prey species (Crimson Rosellas, Eastern Rosellas, Galah and European Starlings) counted near Canberra from Jun. 1982–Jan. 1986 (Olsen et al. 1991). Seasons are: spring (Oct.–Dec.) when peregrine chicks are being fed as nestlings and as fledglings; summer (Jan.–Mar.) when peregrine chicks are achieving independence; autumn (Apr.–Jun.) when there is no breeding activity; and winter (Jul.–Sept.) when peregrines initiate breeding and egg-laying.

Season	Peregrine Falcon Breeding Stage	Numbers of All 77 Bird Species Seen/ month	Numbers of Four Main Prey Species Seen/ month
Spring	young fed by parents	322	60
Summer	independence of young	492	165
Autumn	non-breeding	459	110
Winter	laying eggs	380	124

Bird Counts Near Canberra. Bird numbers, for all species analyzed by Olsen et al. (1991) peaked during summer and autumn when nestling Peregrine Falcons had fledged and were gaining independence (Table 2). Bird numbers were at their lowest during spring when Peregrine Falcons were feeding young in the nest. This pattern was even more pronounced when only the four major prey species were considered (Table 2).

Discussion

The young of cavity-nesting species, including the four major prey species were not available to Peregrine Falcons until the prey fledged. The peak of fledged prey did not occur when peregrines were feeding their nestlings, but during summer and autumn after peregrine young had fledged. Birds generally, and the four main prey species in particular, were most abundant after the peregrines fledged. Starlings may be one species that is more available to nestling peregrines than other prey species. We believe these measures of adult and fledgling bird prey abundance are also good measures of bird prey availability because adult and fledglings of the four main prey species are generally seen in open areas and do not leave the general region where they breed (Taylor and C.O.G. 1992).

Peregrine Falcons need about 4 mo to complete a breeding cycle. Breeding later in the year than they currently do could increase the quantity of food available to adults when feeding their young in the nest, but fledged peregrines would then encounter smaller populations of inexperienced prey fledglings. Experienced parrots, European Starlings, and other prey are much more difficult for recently fledged Peregrine Falcons to capture. British Falconers described how they caught young inexperienced bird prey with young inexperienced falcons, but this became more difficult as the season progressed and the quarry gained experience (Michell 1900). As the year progresses, young prey may flock together or learn to use cover and make hunting more difficult or dangerous for falcons (Olsen 1989). For raptors feeding primarily on birds, prey abundance at the time of rearing nestlings, and prey abundance *per se* at the time of fledging, may not be the most important considerations in the timing of the breeding season. Young Peregrine Falcons must learn to hunt inexperienced prey before this prey gains experience at evading capture. This strategy is likely to maximize survival and may be the ultimate factor in determining the timing of breeding.

Cade (1960), Harris (1981), and Falk and Moller (1988) have indicated that prey was abundant when arctic peregrines hatched their young, but Sherrod (1983) believed that arctic Peregrine Falcons hastened their departure southward because prey species migrate out of the north. These peregrines may find prey particularly abundant on their southern wintering grounds (Enderson et al. 1991), so fledged peregrines could gain hunting experience on juvenile prey that has migrated from the Arctic or is resident on these migration routes and wintering grounds.

We believe that recently fledged and recently independent Peregrine Falcons in Australia need young, inexperienced prey to learn to hunt and the data presented here indicate that the timing of breeding allows this to happen. Further studies are needed to determine whether fledged and recently independent young of different peregrine subspecies, or other raptor species need inexperienced prey in order to learn to hunt and whether they experience peaks in prey availability during the nestling, fledging or post-fledging stage of their breeding cycles.

Acknowledgments

Thanks are due to the Australian Bird and Bat Banding Scheme, the Nest Record Scheme, Ian Taylor and the

Canberra Ornithologists group for access to data. Thanks go also to Les Boyd, David Ellis, Joseph Schmutz, Todd Sherer, Steve Sherrod, Stephen Turner, and Clayton White for helpful comments on the manuscript.

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Received 11 February 1993; accepted 1 June 1993